

MORPHOLOGY OF THE MOUTH PARTS AND ANTENNA OF THE LARVA
OF THE CLOVER STEM BORER, *LANGURIA MOZARDI* LATREILLE
(COLEOPTERA: LANGURIIDAE)

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Abstract.—The morphology of the mouth parts and antennae, including the sensilla on these structures, is described. The mouth parts have several types of sensilla (basiconica, digitiformia, chaetica, trichoidea, campaniformia, and coronal pegs). The apex of each labial (10 sensilla) and maxillary (11 sensilla) palpus has the highest number of sensilla. The striated region on each mandible is composed of several striae and each of these has several rows of blunt, stout pegs. The antennae possess trichoid, basiconic, campaniform, and placoid sensilla and an antennal sensory appendix which is situated on segment 2.

Key Words: Languriidae, *Languria mozardi*, larva, mouth parts, antennae, sensilla

The clover stem borer, *Languria mozardi* Latreille, is nearly ubiquitous in North America on a wide range of cultivated and wild host plants (Wildermuth and Gates 1920). Adults occur frequently in the annual clovers *Trifolium incarnatum* L. (crimson clover), *T. vesiculosum* Savi (arrowleaf clover), and *T. alexandrinum* L. (berseem clover), grown for forage, soil stabilization, and as cover crops in the Southeast.

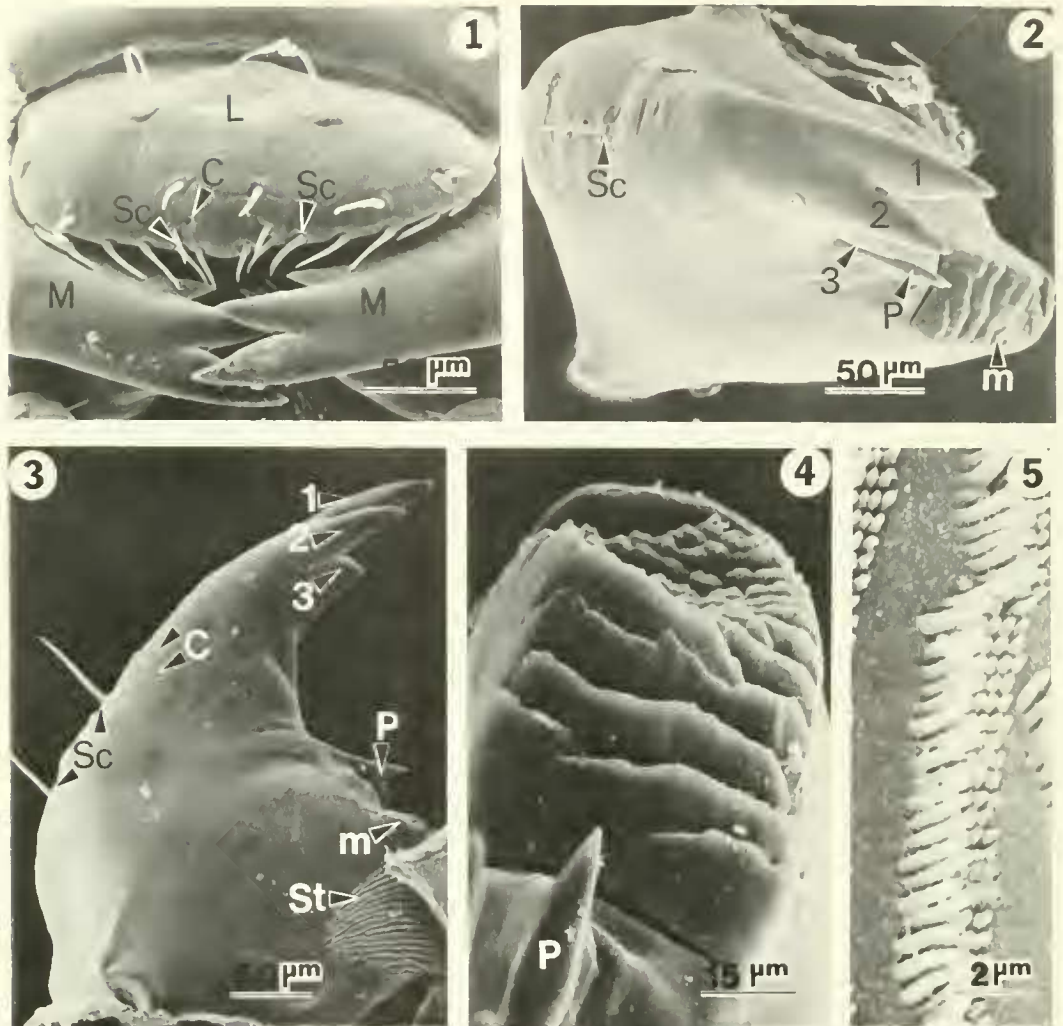
The clover stem borer causes lodging, reduced seed set and poor forage quality as a result of removal of stem tissue, loss of foliage under stress, and increased fiber content (Wildermuth and Gates 1920). The impact of *L. mozardi* on forage production has probably been underestimated because of the seclusive nature of the adults and the cryptic habits of the larvae. The insect is likely to be of economic importance where clovers are grown for hay or seed production.

Wildermuth and Gates (1920) recommended cultural control through crop ro-

tation, early cutting for hay production, and sanitation of field margins to reduce overwintering populations. Selection and breeding of clovers for stem characteristics to reduce establishment and survival of the larva would be an alternative control method. The present studies were initiated to describe the morphology, distribution, and number of sensory receptors on larval mouth parts and antennae of *L. mozardi* that may mediate feeding or tunneling activity of the larva through contact with the host plant.

MATERIALS AND METHODS

Specimens of final (5th) instar larvae of *L. mozardi* were reared on artificial diet (Rose and McCabe 1973). Use of the diet permitted verification of molting to ensure that 5th instar larvae were examined. The techniques for SEM and staining the specimens are given in Baker et al. (1986). All SEM observations are based on 8 last (5th) instar larvae.



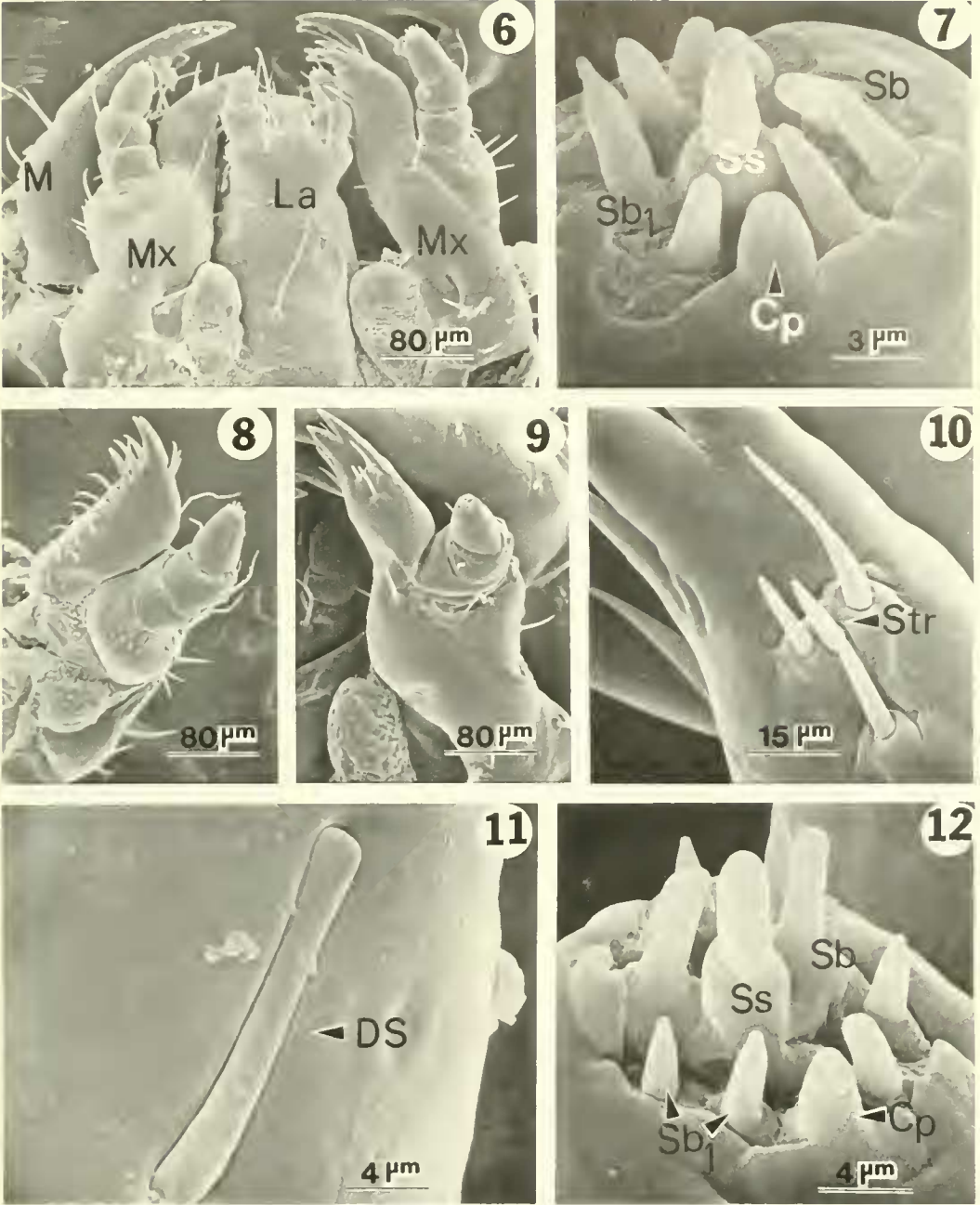
Figs. 1-5. Labrum and mandibles of *L. mozdari*. 1. Distal row of sensilla chaetica on the labrum that extend to the mandibles. 2. Mandible, apical view. 3. Mandible, ectal surface. 4. Molar region. 5. Stria composed of several rows of stout, conical setae. C = campaniform sensillum; L = labrum; M = mandible; m = mola; P = prosthaca; Sc = sensillum chaeticum; St = stria; 1, 2, 3 = mandibular dentes.

RESULTS

The broad, rounded labrum has 24 sensilla chaetica that are mostly situated on the posterior edge of the labrum where they come in contact with the mandibles (Fig. 1). Just above these sensilla, there are 2 campaniform sensilla that are situated near the mid-line of the labrum.

The mandibles have a tridentate apex, a distinct mola, a small and pointed prosthaca and a striated region near the mola (Figs.

2, 3, 4). The 2 apical teeth are similar in size while the basal tooth is smaller. A prosthaca is distad of the mola which is deeply grooved and the grooves increase in density from the basal to the distal region of the mola. Laterad of the mola is a striated region (at low magnifications) but each stria (at high magnifications) is composed of several rows of blunt, stout spines (Figs. 3, 5). Two sensilla chaetica and several campaniform sensilla are situated on the ectal surface of the mandibles (Fig. 3).



Figs. 6-12. Labial and maxillary regions of the mouth parts. 6. Labium, maxillae, and mandibles. 7. Labial palpus, apex. 8. Maxilla, inner surface. 9. Maxilla, outer surface. 10. Sensilla trichodea at base of maxillary denticles. 11. Digitiform sensillum. 12. Sensilla on apex of maxillary palpus. Cp = coronal peg; DS = digitiform sensillum; La = labium; M = mandible; Mx = maxilla; Sb = sensillum basiconicum (blunt); Sb₁ = sensillum basiconicum (tapered); Ss = sensillum styloconicum; Str = sensillum trichodeum.

There is a total of 8 trichoid sensilla on the ligula, mentum, and submentum of the labium (Fig. 6). The labial palpi are 2-segmented and the 2nd segment is longer. At the apex of segment 2 there are 10 sensilla (Fig. 7). The central sensory receptor is a styloconic sensillum which has a short base with a long peg (Fig. 7). There are 8 sensilla basiconica, 7 that are blunt and one that has a tapered tip (Fig. 7). These sensilla are located on the periphery of the terminal palpal segment. There is also one dome shaped sensillum that is situated on a cuticular protrusion (Fig. 7). This sensillum is known as a coronal peg (Doane and Klingler 1978).

The maxilla is well developed with a 3-segmented palpus and a mala which is long and curved with 2 large dentes at the apex (Figs. 8, 9). Just below the dentes there is a row of large sensilla chaetica on the inner surface of the mala (Fig. 8), and on the outer surface, 4 sensilla trichoidea are located at the base of the dentes (Figs. 9, 10).

The maxillary palpi are 3-segmented and the 3rd is the longest. There are 2 sensilla chaetica on each palpal segment and 11 sensilla are situated on the apex of segment 3 (Figs. 8, 9, 12). These sensilla are similar to those on the apex of the labial palpus but there are more tapered basiconic sensilla on the maxillary palpus (Fig. 12). A single digitiform sensillum is located on the inner surface of the last palpal segment (Fig. 11). The stipe and cardo are asperate (Fig. 8). There are 2 pouch-like structures that are situated between the submentum of the labium and the cardo of each maxilla (Fig. 6). These structures are also asperate.

There are 3 antennal segments and segment 2 is the longest (Fig. 13). Segment 1 is devoid of any hair-like sensory structures but there are 4 campaniform sensilla (Figs. 13, 14). On the apical periphery of segment 2 there are 5 blunt trichoid sensilla (Figs. 14, 15). A single, long sensillum chaeticum is situated on the outer, lateral surface of subsegment 2 (Fig. 13). The antennal sen-

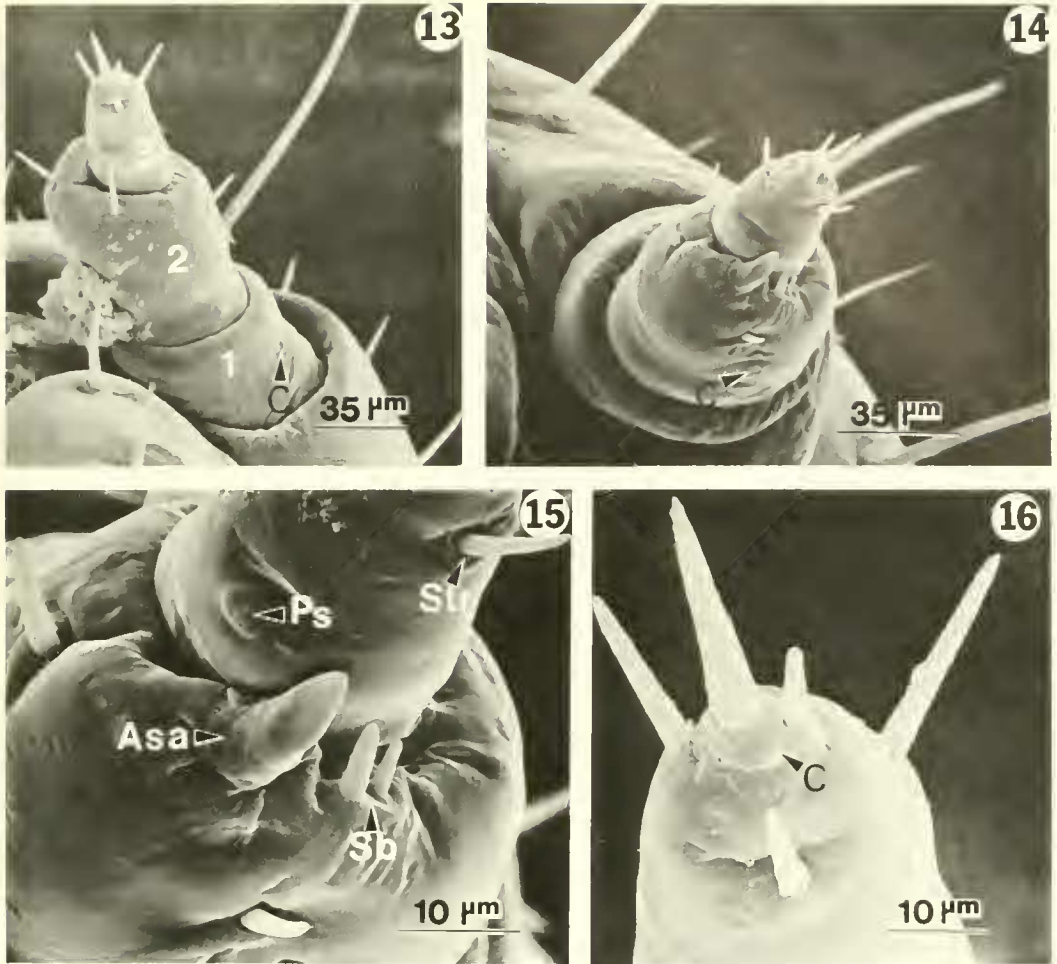
sory appendix is on the ventral side of segment 2 near the intersegmental membrane between segments 2 and 3 (Fig. 15). Laterad of this sensillum there are 2 sensilla basiconica (Fig. 15).

Segment 3 has a raised area at the apex on which are situated 3 sensilla, a campaniform sensillum, and a trichoid and basiconic peg (Fig. 16). Just proximal of these receptors are 3 trichoid sensilla (Fig. 16). A placoid sensillum is situated on the ventral surface of segment 3 near the antennal sensory appendix (Fig. 15). Only the sensilla chaetica and campaniformia that are situated on the mouth parts and antennae do not stain with crystal violet or reduced silver, thus indicating their nonporosity. All other sensilla that are mentioned pick up these stains indicating that these sensilla have a porous cuticular peg.

DISCUSSION

The close proximity of the labral sensilla chaetica to the underlying mandibles indicates that these sensilla probably act in monitoring the position of the labrum and mandibles during feeding. Campaniform sensilla are known to act as stress receptors and the 2 sensilla situated on the middle portion of the labrum may function as cuticular stress receptors.

In previous descriptions of larval languriid mandibles (Comstock and Comstock 1916, Peterson 1951) there is no mention of the structure of the molar surface and the striae that occur laterad the mola. The deeply grooved molar surface aids in grinding plant material that is to be ingested. Several rows of blunt spines comprise each of the striae that are present on the mandibles. They are also present on the same region of *Tribolium* larvae (Kvenborg 1977). The function of the striae is unknown, but they could be involved in stridulation or grooming. The 2 nonporous sensilla chaetica and several campaniform sensilla on the ectal surface of each mandible probably function as those located on the labrum, to monitor



Figs. 13–16. Larval antenna of *L. mozardi*. 13. Antenna, dorsal surface. 14. Antenna, ventral surface. 15. Intersegmental region between antennal segments 2 and 3. 16. Antenna, apex. Asa = antennal sensory appendix; C = campaniform sensillum; Ps = placoid sensillum; Sb = sensillum basiconicum; Str = sensillum trichodeum.

cuticular stress and to relay information on the position of the mouth parts in relation to one another.

The general structure of the labium is similar to the descriptions for other languriid species (Wildermuth and Gates 1920, Piper 1978). *L. mozardi* differs from *Acropteroxys gracilis* (Newman) in the number and types of sensilla situated on the apex of the labial palpi. *A. gracilis* has 11–12 basiconic sensilla on the apex of the palpus (Piper 1978), while *L. mozardi* has a total of 9–10 sensilla but there are 2 types of basiconic

sensilla, a sensillum styloconicum and a coronal peg.

A similar situation exists when one compares the number and types of sensilla on the maxillary palpal apex of *L. mozardi* and *A. gracilis*. *L. mozardi* has 10–11 sensilla, 1 styloconic and coronal sensillum and 2 types of basiconic sensilla while *A. gracilis* has 11–12 basiconic sensilla. The total number of apical sensilla on the maxillary (11) and labial (10) palpi of *L. mozardi* is similar to what is found on *Tribolium* larvae (13 & 12) (Ryan and Behan 1973) and

Hypera larvae (12 & 11) (Bland, 1983). But the various types of apical sensilla on these structures of *L. mozardi* resemble the apical sensilla on wireworm larvae (Doane and Klingler 1978).

The maxillary and labial apical basiconic and styloconic sensilla stain with crystal violet and reduced silver indicating that these sensilla have a porous cuticle. Also, behavioral and electrophysiological studies on other coleopterous larvae have shown that similar receptors respond to CO₂ and other chemicals and therefore may be considered to be chemoreceptors (Klingler 1966, White et al. 1974, Doane and Klingler 1978, Mitchell 1978).

The external structure of the digitiform sensillum is similar to what is found on other coleopterous larvae (Zacharuk et al. 1977, Doane and Klingler 1978, Guse and Honomichl 1980, Honomichl 1980). Ultrastructural and electrophysiological evidence indicate that this sensillum is a type of mechanoreceptor that is involved in monitoring the larva's tunneling activity (Zacharuk et al. 1977).

The total number of antennal sensilla on *L. mozardi* (22) is similar to *Tenebrio molitor* L. (24 sensilla) (Pierantoni 1969) and *Tribolium* larvae (21 sensilla) (Behan and Ryan 1978). The morphology of the basiconic and porous trichoid sensilla resembles that found on other coleopterous larvae, and ultrastructural studies indicate that these sensilla are chemoreceptors (Behan and Ryan 1978, Bloom et al. 1982a, b). The antennal sensory appendix of *L. mozardi* is similar in morphology and position on the antenna as that on elaterid larvae (Zacharuk 1962). The fine structure of the sensory appendix suggests that it functions as an olfactory receptor (Scott and Zacharuk 1971). The ultrastructure of the placoid sensillum on tenebrionid larvae indicates a chemosensory function (Behan and Ryan 1978, Bloom et al. 1982), but electrophysiological data is lacking.

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